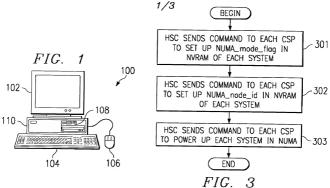
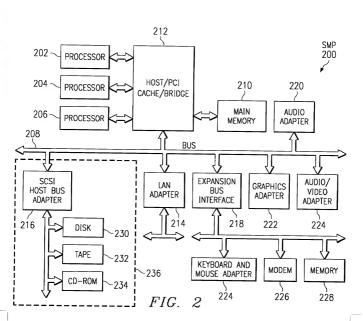
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Lee et al.

Method and Apparatus to Boot a Non-Uniform-Memory-Access (NUMA) Machine





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AUS920010196US1 Leë et al. Method and Apparatus to Boot a Non-Uniform-Memory-Access (NUMA) Machine 2/3 BEGIN CSP CONFIGURES AND TESTS HOST **PROCESSORS** FIG. 4 402 CSP CONFIGURES AND CSP PERMANENTLY MAPS TESTS HOST MEMORY LOCAL SYSTEM MEMORY AT STARTING ADDRESS CSP DETECTS Y THAT MEMORY MAP HAS RESERVED FOR NUMA_mode_flag=0 THEN CONFIGURES AND TESTS NODE ID X NUMA MEMORY 409 408 404 CSP INFORMS HSC 413 OF THE VERSION OF X=NUMA_node_id LOADED SYSTEM CSP INITIALIZES ALL FIRMWARE IMAGE HOST POWFR4 CSP SETS UP THE BASE PROCESSORS WITH ADDRESSES OF ALL RIO CSP WAITS FOR HSC TO MSR[0]=1, MSR[3]=0.HUBS USING SYSTEM CONFIRM THAT THE MSR[19]=1, HID4[0]=1. MEMORY MAP RESERVED LOADED SYSTEM HID4[1,2]=2FOR NODE ID X FIRMWARE IMAGE IS THE HID4[3..6]=0.SAME AS THE OTHER 406 HID4[62,63]=0NODES' FIRMWARE IMAGE PIR[23..25] = XCSP TEMPORARILY MAPS HID4[7..22]=(Y>>26)411 LOCAL SYSTEM MEMORY 410 SPRG0=NUMA_mode_flag STARTING AT ADDRESS O CSP CONFIGURES LOCAL NUMA ADAPTERS TO CSP SETS ALL HOST CSP LOADS SYSTEM CONNECT THE SYSTEM POWER4 PROCESSORS' INTO THE FINAL NUMA FIRMWARE IMAGE PROGRAM COUNTERS MACHINE INTO ITS LOCAL (NIA) TO SYSTEM SYSTEM MEMORY FIRMWARE'S ENTRY POINT (0X100)CSP INITIALIZES THE LOCAL NODAL-TIME-BASE 415 REGISTER 414 CSP RELEASES ALL HOST 412 POWER4 PROCESSORS SO THEY CAN START

EXECUTING SYSTEM FIRMWARE END

Method and Apparatus to Boot a Non-Uniform-Memory-Access (NUMA) Machine BEGIN PROCESSORS OF NODAL MASTER EACH NODE COMPETE PROCESSOR PERFORMS TO BE THE NODAL RIO HUBS MASTER PROCESSOR CONFIGURATION OF THE LOCAL NODE 502 501 508 507 NODAL MASTER YES PROCESSOR? NODAL MASTER FIG. 5 PROCESSOR SETS TIME BASE REGISTER NO NODAL SLAVE NUMA MASTER NODAL MASTER PROCESSORS WAIT FOR PROCESSOR COLLECTS NODAL MASTER PROCESSOR INITIATES ALL UPDATED NODAL 1-ON-1 HANDSHAKES PROCESSOR TO INITIATE RIO HUBS, STRUCTURES. 1-ON-1 HANDSHAKE WITH ALL NODAL SLAVE ALL NODAL PROCESSOR **PROCESSORS** STATUS, AND NODAL 504 503 SYSTEM MEMORY STATUS 510 509 NODAL SLAVE 515 514 SET INTERRUPT MASK PROCESSORS SET REGISTERS TIME BASE REGISTERS NUMA MASTER PROCESSOR LOADS OPEN FIRMWARE AND EXECUTES NODAL MASTER NODAL SLAVE IT TO GENERATE OPEN PROCESSOR COMPETES PROCESSORS SWITCH FIRMWARE DEVICE TREE TO BE THE NUMA TO HYPER-VISOR FOR THE ENTIRE NUMA MASTER PROCESSOR ENVIRONMENT TO MACHINE BECOME NUMA SLAVE 511 **PROCESSORS** NUMA MASTER NUMA MASTER YES 505 PROCESSOR EXECUTES PROCESSOR? OPEN FIRMWARE TO ALL NUMA SLAVE 513 ĮNO LOAD AIX INTO SYSTEM 512 PROCESSORS NOW MEMORY AND TRANSFER EXECUTE FIRMWARE ALL NODAL MASTER CONTROL TO AIX RESIDING IN NODE O. PROCESSORS WHICH AND WAIT FOR NUMA 517 FAILED TO BECOME 516 MASTER PROCESSOR TO THE NUMA MASTER ALLOW THEM TO NUMA MASTER PROCESSOR WAIT PROCEED FURTHER PROCESSOR RUNS AIX FOR THE NUMA CODE TO TAKE ALL MASTER PROCESSOR 506 TO INITIATE 1-ON-1 NUMA SLAVE PROCESSORS TO THEIR HANDSHAKES, THEN DESTINATION IN AIX THEY BECOME NUMA SLAVE PROCESSORS **END**

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